

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Previously Presented) A method for controlling a switch comprising:
a number of input ports, each receiving data cells on a respective link;
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;
a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:
monitoring the remaining available buffer space AS of the shared buffer;
estimating the expected total content LE of the links;
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
if the free margin sinks below a threshold $AS-LE < A$, then a selected link is paused; and
if the free margin thereafter raises above a threshold $AS-LE > B$, then a selected paused link is un-paused.
2. (Original) A method according to claim 1, wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link.
3. (Original) A method according to claim 2, wherein the content LE of the links is estimated as the sum of the contents of all the input links.

4. (Original) A method according to claim 3, wherein the estimation of the content LE of the links takes into account the different link lengths and bit rates.
5. (Previously presented) A method according to claim 4, wherein each link estimate is based on a model of the behavior of each port.
6. (Original) A method according to claim 5, wherein the model consists of a curve having different segments, each segment reflecting a specific state of the port.
7. (Original) A method according to claim 6, wherein the states include:
 - a state in which the link is full and contains a maximum amount of data;
 - a state in which the port is to be paused and is waiting for a pause frame to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;
 - a state in which a pause frame is sent and the port is waiting for a fixed duration to allow a packet to leave the sender, and in which the link remains at the maximum amount;
 - a state in which the pause frame has reached the sender and the link content is decreased linearly with time to a minimum amount;
 - a state in which the port is to be un-paused and is waiting for an un-pause frame to be sent and in which the link remains constant for a fixed duration; and
 - a state in which an un-pause frame is sent and the link content is increased linearly with time to the maximum amount.
8. (Original) A method according to claim 7, wherein the maximum amount of data equals twice as much as a round trip content plus two full-sized packets.
9. (Original) A method according to claim 7, wherein the minimum amount of data equals one full-sized packet.
10. (Original) A method according to claim 7, wherein the slopes of the linear increase and decrease depend on the bit rate of the respective link.

11. (Original) A method according to claim 2, wherein the most offending sender is paused first.
12. (Original) A method according to claim 2, wherein the least offending sender is un-paused first.
13. (Original) A method according to claim 11 or 12, wherein offending senders are detected by means of an overflow sum counter OFS.
14. (Original) A method according to claim 13, wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port.
15. (Original) A method according to claim 14, wherein the counter OFS of each input port is increased with the packet length, each time the input port sends a packet to a congested output port.
16. (Original) A method according to claim 14, wherein the counter OFS is reset to zero when its associated input port receives an un-pause frame
17. (Original) A method according to claim 14, wherein an output port is considered congested if the queue length thereof exceeds a threshold.
18. (Previously Presented) A method for controlling a switch comprising: a number of input ports, each receiving data cells on a respective link; a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue; a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:
 - monitoring the remaining available buffer space AS of the shared buffer;
 - estimating the expected total content LE of the links;

calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
if the free margin sinks below a threshold $AS-LE < A$, then a selected link is paused;
if the free margin thereafter raises above a threshold $AS-LE > B$, then a selected paused link is un-paused;
wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;
wherein the most offending sender is paused first or wherein the least offending sender is un-paused first;
wherein offending senders are detected by means of an overflow sum counter OFS;
wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port; and
wherein an output port is considered congested if the queue length thereof exceeds a threshold; and
wherein the queue length threshold equals a maximum length packet.

19. (Previously Presented) A method for controlling a switch comprising: a number of input ports, each receiving data cells on a respective link; a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue; a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:

monitoring the remaining available buffer space AS of the shared buffer;
estimating the expected total content LE of the links;
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
if the free margin sinks below a threshold $AS-LE < A$, then a selected link is paused;
if the free margin thereafter raises above a threshold $AS-LE > B$, then a selected paused link is un-paused;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the most offending sender is paused first or wherein the least offending sender is un-paused first;

wherein offending senders are detected by means of an overflow sum counter OFS, and wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, all counters are divided by 2.

20. (Previously Presented) A method for controlling a switch comprising: a number of input ports, each receiving data cells on a respective link; a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue; a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:

monitoring the remaining available buffer space AS of the shared buffer;

estimating the expected total content LE of the links;

calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM = AS - LE$;

if the free margin sinks below a threshold $AS - LE < A$, then a selected link is paused;

if the free margin thereafter raises above a threshold $AS - LE > B$, then a selected paused link is un-paused

if the free margin thereafter raises above a threshold $AS - LE > B$, then a selected paused link is un-paused;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the most offending sender is paused first or wherein the least offending sender is un-paused first;

wherein offending senders are detected by means of an overflow sum counter OFS; and wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, the value of the smallest counter is subtracted from all the counters.

21. (Original) A method according to claim 13, wherein all the OFS counters are decreased linearly with time.
22. (Original) A method according to claim 1, wherein the threshold A is set to zero ($A = 0$).
23. (Original) A method according to claim 1, wherein the threshold A is set to a negative value ($A < 0$).
24. (Previously presented) A method according to claim 1, wherein the threshold A is less than or equal to the threshold B ($A \leq B$).
25. (Original) A switch comprising:
 - a number of input ports, each receiving data cells on a respective link;
 - a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;
 - a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:
 - monitoring the remaining available buffer space AS of the shared buffer;
 - estimating the expected total content LE of the links;
 - calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM = AS - LE$;
 - wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold $AS - LE < A$; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold $AS - LE > B$.

26. (Original) A switch according to claim 25, wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link.
27. (Original) A switch according to claim 26, wherein the content LE of the links is estimated as the sum of the contents of all the input links.
28. (Original) A switch according to claim 27, wherein the estimation of the content LE of the links takes into account the different link lengths and bit rates.
29. (Currently Amended) A switch according to claim 28, wherein each ~~link~~ link estimate is based on a model of the behavior of each port.
30. (Original) A switch according to claim 29, wherein the model consists of a curve having different segments, each segment reflecting a specific state of the port.
31. (Original) A switch according to claim 30, wherein the states include:
a state in which the link is full and contains a maximum amount of data;
a state in which the port is to be paused and is waiting for a pause frame to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;
a state in which a pause frame is sent and the port is waiting for a fixed duration to allow a packet to leave the sender, and in which the link remains at the maximum amount;
a state in which the pause frame has reached the sender and the link content is decreased linearly with time to a minimum amount;
a state in which the port is to be un-paused and is waiting for an un-pause frame to be sent and in which the link remains constant for a fixed duration; and
a state in which an un-pause frame is sent and the link content is increased linearly with time to the maximum amount.

32. (Original) A switch according to claim 31, wherein the maximum amount of data equals twice as much as a round trip content plus two full-sized packets.
33. (Original) A switch according to claim 31, wherein the minimum amount of data equals one full-sized packet.
34. (Original) A switch according to claim 31, wherein the slopes of the linear increase and decrease depend on the bit rate of the respective link.
35. (Original) A switch according to claim 26, wherein the flow control means is arranged to pause the most offending sender first.
36. (Original) A switch according to claim 26, wherein the flow control means is arranged to un-pause the least offending sender first.
37. (Original) A switch according to claim 35 or 36, wherein the flow control means contain an overflow sum counter OFS to detect offending senders.
38. (Original) A switch according to claim 37, wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port.
39. (Original) A switch according to claim 38, wherein the counter OFS of each input port is increased with the packet length, each time the input port sends a packet to a congested output port.
40. (Original) A switch according to claim 38, wherein the counter OFS is reset to zero when its associated input port receives an un-pause frame
41. (Original) A switch according to claim 38, wherein an output port is considered congested if the queue length thereof exceeds a threshold.

42. (Previously Presented) A switch comprising:
- a number of input ports, each receiving data cells on a respective link;
 - a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;
 - a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:
 - monitoring the remaining available buffer space AS of the shared buffer;
 - estimating the expected total content LE of the links;
 - calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
 - wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold $AS-LE < A$; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold $AS-LE > B$;
 - wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;
 - wherein the flow control means is arranged to pause the most offending sender first; or wherein the flow control means is arranged to un-pause the least offending sender first;
 - wherein the flow control means contain an overflow sum counter OFS to detect offending senders;
 - wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port;
 - wherein an output port is considered congested if the queue length thereof exceeds a threshold; and
 - wherein the queue length threshold equals a maximum length packet.

43. (Previously Presented) A switch comprising:

a number of input ports, each receiving data cells on a respective link;
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;
a flow control means for pausing and un-pausing senders on selected links, the switch further including means for:
monitoring the remaining available buffer space AS of the shared buffer;
estimating the expected total content LE of the links;
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold $AS-LE < A$; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold $AS-LE > B$;
wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;
wherein the flow control means is arranged to pause the most offending sender first, or wherein the flow control means is arranged to un-pause the least offending sender first;
wherein the flow control means contain an overflow sum counter OFS to detect offending senders; and
wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, all counters are divided by 2.

44. (Previously Presented) A switch comprising:

a number of input ports, each receiving data cells on a respective link,
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;

a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:

- monitoring the remaining available buffer space AS of the shared buffer;
- estimating the expected total content LE of the links;
- calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links $FM=AS-LE$;
- wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold $AS-LE < A$; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold $AS-LE > B$;
- wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;
- wherein the flow control means is arranged to pause the most offending sender first;
- wherein the flow control means is arranged to un-pause the least offending sender first;
- wherein the flow control means contain an overflow sum counter OFS to detect offending senders; and
- wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, the value of the smallest counter is subtracted from all the counters.

45. (Original) A switch according to claim 37, wherein all the OFS counters are decreased linearly with time.
46. (Original) A switch according to claim 25, wherein the threshold A is set to zero ($A = 0$).
47. (Original) A switch according to claim 25, wherein the threshold A is set to a negative value ($A < 0$).
48. (Original) A switch according to claim 25, wherein the threshold A is less than or equal to the threshold B ($A \leq B$).